Title: EPR (Einstein-Podolsky-Rosen) experiments and Physical Reality.

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Abstract: Efforts based on the results of sophisticated experiments and meant to fit EPR effects in the accepted paradigms of Physics, remain unsatisfactory. A valid Physical Reality model (see Ref1: vixra.org/abs/1604.0230) may help to solve the puzzle.

1. Introduction.

- Any deductive and evolutionary approach of a consistent Physical Reality (PhR) model (see **Ref1**) or **our cosmos,**
    - starting from **NIHIL**, a perfectly homogeneous, unbounded and symmetric state
    - broken by an event that created a single **point - object**,
    - a point with a single discriminating property called **charge,** charge being the sole difference between something and nothing,
    - and subject to an evolutionary process dictated by six simple **base laws**

    … can only be validated by logically deduced processes, patterns, rules and statements that properly match observed phenomena and proven laws of an inductive and exact science (i.e. Physics),

    … a method which will require a consistent definition of objects and properties that are considered to be equivalent in the two approaches.

- This certainly goes for issues proper to classical physics (e.g., a physicist may claim: " we are able to describe nature successfully in just 3 spatial dimensions" - but what does "dimension" mean in terms of PhR?), but also in those fields where extreme experimental conditions did require new theoretical paradigms and terms (e.g. "Relativistic quantum field theories" or "General relativity").
- EPR effects (the main topic of this text) are a separate class of experimental results, not just because producing and maintaining coherent particles and observing their behavior has proven to be extremely difficult, but also because various potential reality-scenarios could lead to different interpretations of the results obtained. Terms and concepts like locality, multi-dimensionality or many-worlds architectures, uncertainty (Heisenberg) or causality, hidden variables, counter-factual definiteness, etc, will remain a source of debate between physicists and philosophers, between " believers and non-believers".
- This PhR model (Ref1) will not settle the matter, as it is to be expected that it will itself be subject to discussions between those who accept its description of what really exists in "our cosmos", and those who don't. What it nevertheless can do is

add some new facts and arguments to the debate that, in the context of this PhR model itself, are vital. Indeed, if they turned out to be wrong, the whole model as such would have to be rejected.

2. Dimensionality and the vacuum.

- In this PhR model, the **creation event** leads to the emergence of two superposed, continuously expanding, spherically symmetric and dense **grids**, filling emptiness (the NIHIL state) with dynamic (i.e., subsequent versions are created and destroyed at an extremely high rate) objects called points and **zerons.**
- Points are clones of the initially created object (or of its dual anti-symmetric version). Indeed, any other distinct and non-composite object would require, on top of the base law's impact, another creation event, an idea that is rejected in this model.
- Zerons are standard subsets of points with a simple and coherent collective behavior. Their more complex life cycles grow, out of two anti-symmetric, entangled double point pairs, as two orthogonal, double sided point strings, driven by a process called **point replication**. Replication will dynamically select and bind elementary points together by the internal exchange of standard **charge info quanta** along multiple **fastest** interaction **paths**. The initial growth cycle of a **standard** zeron pattern comes to an end after 137 replication steps (numbered up to a maximum index value i-max of a **return state**) as the final outcome of a phase-shifting interaction between adjacent zerons. Reaching this limit means that the probability of an external interaction has exceeded the probability of an internal interaction between points along distinct replication direction, leading (till then) to the further growth of a zeron pattern and a reduction of its dimensionality. We apply the term "standard" because at such an elementary level, no discriminating property exists that would make zerons different. Replication along a fastest path protects the ongoing process against external perturbations. Finally, 137 is a prime number and prohibits the appearance of zeron subclasses with smaller replication lengths.
- After interaction between neighbor zerons in i-max, a subsequent shrinking cycle along the same path reduces the two zerons involved to a **contracted,** pure charge info **state.** In this state, and after inversion (in accordance with the base laws), a new zeron version with anti-symmetric properties will emerge.
- A zeron is able to maintain over a single life cycle (i.e. one growth + shrinking process) a unit charge quantum (+ or – **q** , a Coulomb unit charge), and over half a life cycle a fixed mass quantum (an excess **hole** quantum, positive or negative depending on the sign of the local point/emptiness or hole ratio, as compared to its standard value in a primitive zeron set).

- The lowest point grid (**CPS**) and the zeron grid (**UZS**) together make up what physics calls “the vacuum”. On average, and “measured” over relevant space-time volumes, both dense, discrete and dynamic grids are homogeneous (at least, without the presence of high level patterns). This means that, again on average, algebraic sums of charge and mass densities are zero, and the grid contents are de facto unobservable to physics: point life cycles are of the order of Planck units.
- **Dimensionality** in a PhR concept is defined as the number of directions along which an object has an equal a-priori-chance or probability to interact successfully with a neighbor object (in an appropriate state) by charge info exchange. If multiple phase shifted interactions take place in parallel along these directions, they are **orthogonal** (in space and local time or phase) to each other, which means that they do not disturb each other’s replication process.
- **Elementary particles** (Physics) are dynamic **patterns** made of selected UZS zerons in proper states, with a coherent behavior (UZS zerons are standard but their life cycles are N-dim and stochastically phase-shifted – coupling is only feasible in proper special critical states). Out of a compact 4-zeron 90° phase shifted **nucleus** with an internal tetrahedron geometry, and after a disruption of its ideal lowest “energy” state by a single charge info exchange with a similar dual 4-zeron pattern, they both grow and shrink through a **zeron replication** process. This means that compliant UZS zerons are, step by step, added to and released from the previous pattern state. A replication process ties zerons together by exchanging charge info quanta **at point level** in critical zeron states (contraction or return states). The return state of a growth cycle (I-max) is reached, not due to the interaction with another particle, but after an internal interaction between the last added and phase shifted string components (the **connectors)** of the pattern itself, leading to an appropriate role inversion of these components and to a subsequent shrinking cycle (a process subject to internal **CPT** – conservation rules). The dual nucleus transforms into a **contra-particle** (with negative mass).
- Contrary to a point replication cycle of a zeron, a modified particle’s growth process might have a variable I-max value, a quantum variable hidden to physics that determines foremost the pattern’s momentum and energy content.
- All this to leads us to conclude that according to this model:
    - Particles are dynamic and short-lived zeron-made patterns on a UZS grid, growing and shrinking out of a nucleus, possessing an intrinsic quasi-perfect 3D symmetry, replicating in a two-sided way in 3 orthogonal directions (**strings –** but indirectly observed as quarks in physics). Their properties (those observable by physics – e.g. particle spin) are mainly determined by the content and the states of their dynamic **connectors.**
    - Subsequent particle versions have rotational degrees of freedom but only when in their contracted state: they are indeed sensitive to the local charge info density distribution and are able to rotate within the limits set

by the intrinsic dimensionality of the UZS (a value N >> 3), taking into account the appropriate conservation rules.

- Successful and periodic interactions between connectors of compliant particles (e.g. dual contra-particles are not fully compliant) will lock in (as "de facto" constraints) some degrees of freedom. All physical observations require direct or indirect interactions between the observer's instruments (via test particles) and the observed object. Direct observation always has an impact on the properties of what is observed. Indirect observation implicitly takes into account the growth of a next version in the contracted state, without changing the energy state of the pattern.
- Interactions between particles and between particles and the grid give patterns the capability to shift over the grid in a quantized manner (momentum), although a quantized shift event requires several subsequent life cycles of a particle before it will effectively take place. Their number depends on the value of the particle's string length (**I-max** – a measure for the energy state) at the time of the initial momentum-exchanging interaction (a **polaron** impact – a 2-zeron charge info pattern). During the time lapse between position shifts, a varying phase state (quantized at point level) of one of the connector zerons will prohibit polaron-like interactions until the motion over the UZS grids effectively takes place (PhR behind the observed "de Broglie" wavelength).
- In a nutshell, and in accordance with PhR: **If Physics observes 3D, this is because particles are patterns with a triple orthogonal quark layout.** These "quarks" are the physical equivalent of the 3 replication directions of zeron strings in N-dim. These directions are the orthogonal growth/shrinking paths of a central spatial symmetric 4-zeron tetrahedron, in fact a coupled antenna and charge info emitter made up of zerons with quasi 90° phase shifted point replication cycles. External observations require co-linear interactions between string connectors in their I-max states which constrains the relative orientation of a pair of coupling-enabled 3D patterns in a N-dim UZS.

- All this means that, if this model is correct, a number of presumptions that are relevant to EPR effects are beyond dispute:
  - The abstract **many worlds** picture and the **collapse of state** of a particle due to observation (QM) are valid even in a non-comprehensive physical description of PhR. Indeed, the double CPS/UZS raster is not part of the present mathematical models when describing cosmic behavior.
  - The observed (by other interacting particles) internal dimensionality of particles is 3 but the underlying dimensionality of the UZS grid is N >> 3. The CPS grid has a dimensionality of M >> N >> 3 and both facts are

completely transparent to physics. The reduction of dimensionality between zerons and points is 137 and this figure is relevant because it quantizes relative phase shifts between zeron life cycles.

3. Locality and c- the speed of light.

- Any form of interaction between particles or particles and the UZS grid are local processes (events or event sequences) **at point level**. So the chance for a charge info quantum to travel over very long distances in a dense double point-zeron grid without being immediately involved in an interaction, seems to be about zero. However, three important remarks are to be made:
    - Charged particles (capable of conserving an observable free charge quantum along one or several phase shifted replication directions and not involved in an internal zeron string coupling as e.g. in neutrons) might have a polarizing impact on UZS zerons in the particle's immediate surroundings / environment. The radial, spherically symmetric distribution of linear polarized and coherent zeron sets forms the PhR behind abstract E-field line configurations in Physics (see "Coulomb's law"). Those impact the probability distribution of successful interactions between particles by enabling the exchange of correctly formatted charge info "momentum" quanta (virtual photons in physics or polarons in PhR terms) and could be seen as intermediaries of what Einstein called "spooky action at a distance". Nevertheless, the real exchange of charge info quanta (each micro-interaction as such) remains a two-sided, phase shifted local processes pair, taking place at both ends of a polarization path.
    - Accelerated (decelerated) particles release (absorb) per step **static**, persistent two-zeron patterns in the UZS (EZPs or polarons in terms of this model - in fact PhR of dark matter and the equivalent of gravitons in Physics), which in turn are PhR behind any gravity field distribution (see also vixra.org/abs/1701.0287). Radial gravity fields emerged historically at the time mass particles started to condensate into massive objects. These graviton or EZP fields have an impact on replicating mass particles by exchanging double charge info packages (polarons) with connectors in two subsequent opposite states, changing or maintaining their motional properties in a slightly asymmetric fashion. "Asymmetric", because their extremely weak net impact is the result of a small difference in EZP density over short distances (twice the replication length) along radial field lines with a global spherically symmetric distribution. This EZP density gradient has an impact on the probability of successive effective interactions with connectors in opposite states (each half a replication period – equivalent a spin 2 behavior). In this case, too, we could talk

about “a spooky action at a distance”, as classically physics assumed that the central mass object was the persistent source of an attractive potential. According to this model, however, that assumption is not correct, except indirectly - when the object is moving perpendicularly to another high-level radial field (e.g. along an elliptic orbit) and has to shift its pattern over the vacuum grids. But even in that case the interactions needed to adjust the fields are local, and are determined by a graviton (EZP) density configuration, historically built up and since then dynamically adjusted.

- Finally (and this third case will interest EPR researchers) there is another, even subtler exception, at least in theory. When two anti-symmetric elementary particles (a chiral or entangled pair, a process according to strict conservation rules) emerge out of a single complex particle, initiated by an internal one-shot charge info exchange event, they can both, under certain conditions, “drop” a two-sided polarization string of locally anti-symmetric EZPs along their quasi-linear propagation paths that briefly maintains a sequence of central holes (a kind of empty tunnel sustained by the locally contracting persistent synchronized 180° phase shifted (EZP) zeron pairs) along which point level charge info is able to travel with little chance to hit another point (and to disappear - if this happens accidently along such a path, coherence (or entanglement) would be lost).
- In this PhR model, a light wave is not a continuous E-B field but a coherent sequence of shortest (I-max = 1) particle-like UZS patterns (in fact with an internal compact double (spin 1) 4-zeron pattern format) called fotinos, emitted in subsequent contracted states in a plane perpendicular to the string, as the outcome of an unbalance between two contracting branches of an accelerated and temporarily asymmetric particle string (a polaron interaction between two particles’ connectors is for each an asymmetric, one-sided process). A single photon (a term used in Physics) is in fact a chain of fotinos, with small fluctuations in charge (E-field) and charge info (B-field) densities (due to a variable emission rate as caused by a changing disequilibrium in the contracting particle’s nucleus) being observed as continuous sinusoidal electromagnetic fields. The fotino emission comes to an end when the particle shifts effectively its position over the UZS grid and reaches a new momentum state in equilibrium at (I-max – 1).
- All this to say that the propagation speed of photon patterns is a typical UZS property, as they are, in fact, nothing but the locus of a fast “moving” versions of anti-symmetric, coherent and replicating mini “zeron-patterns” (fotinos). The extreme value c of their speed corresponds with a shortest I-max value of 1 for replicating fotinos . This value is a rounded figure at UZS level – further acceleration of the antenna particle cancels out at point

level and just increases its mass by lengthening, through constructive interference of charge info, the duration of its contraction state (PhR behind a Lorentz transformation formula, written as power series). It is obvious that in case of point info propagation along an zeron-free central EZP-tunnel the speed will be much higher and at least 137 * c. We must not forget that physical unit quantities like action (Planck value **h**) and unit charge (+/- **q**) are typical point level (or CPS) quantities in this PhR model. The value c, on the other hand, is a quantity at UZS level. Effective speeds at CPS level (along point info paths) should be at least 137 times higher than c. Charge info velocities in absolute emptiness (e.g. between points) might exceed this value even further, by an unknown factor.

- These reflections imply that low-level information exchange about the real-time states of two coherent particles are able to travel at speeds far exceeding the speed of light: the measurement of a property of one of them will either lead to de-coherence of the pair or to a complementary change of the equivalent property of the partner. Under this assumption the meaning of locality changes drastically.
- As an indirect but more global statement, we conclude that the hypothetical existence of a double layered, quantized grid which Physics cannot observe directly, complicates reconciliation between the two approaches.

4. Causality and determinism.

- This PhR model accepts the principle of causality: all local processes related to the impact of an appropriate action quantum (axion h/2 or polaron h-see Ref1), have been caused by charge info emitted **before** by another pattern. The source of emission might be a particle in a return or contraction state or a pseudo-static field particle like an EZP. The path of an emitted fraction of charge info is initially unidirectional (at least until successful coupling) and takes place at a non-infinite speed <= c_v (one of the base laws). The coupling law dictates that both the emitter and the successfully coupled receiver are impacted by the exchange of charge info, a process that takes place at a slightly lower effective speed c_p (in accordance with conservation rules). No “third party” can be involved while such a selected “fastest exchange” process is going on, although “change” means that multi-dimensional info emission as such takes place immediately at both sides.
- Causality, however, does not imply full determinism. This is not only true “in practice”, when applied to the behavior-over-time of an individual object impacted by an extremely high number of surrounding time-varying and sometimes complex patterns, but it is fundamentally linked to one of the base laws. Indeed, the superposition law states that charge info packages, emitted in

an isotropic fashion by a spherical antenna (e.g. a single point), are subject to destructive interference with other properly synchronized info packages, arriving simultaneously in common locations, a simple fact that makes the successful impact of any individual and residual package on its surroundings highly unpredictable.

- A second unpredictable effect is that of constructive interference with external charge info in the zeron contraction state, leading to a delay (or phase shift) in its point replication schema (a polaron impact).
- Nevertheless, the same superposition law (and its impact on probability distributions of successful interactions) forms the PhR behind principles and methods in physics like renormalization and the successful application of Feynman's path integral methods. The choice of the fastest effective path (PhR behind Fermat's principle) for a successful coupling by single or multiple charge info exchange(s) between two patterns is based on the cancellation of the contribution of charge info, traveling along other potential paths, as a result of the overall symmetry of the setup, a fact that at least partly explains in a PhR perspective, the importance of symmetry in physics.
- Physics (QM) asserts that a quantum object can be in many superposed states simultaneously (reinforcing the idea of non-determinism). PhR, however, does not allow for this use of the term "simultaneously". Between two effective position shifts of a particle over the UZS grid, many particle life cycles (growth and contraction phases) take place, a number depending on the value of I-max. During an experiment, we are not even observing the same particle version after contraction, although successive versions conserve certain (but not all – think on neutron decay) of their ancestors' properties (this supports the idea of superposed states). In this sense, the common view of an electron as an extremely long-lived object is erroneous – the pattern as such is persistent, not a single occurrence or version. The duration of a single life cycle is, in any case, too short to be detectable by physical experiments today (and will probably remain so). It takes abstract complex number representations (including phase angles) and probability amplitudes for physics to compensate this lack of insight into the internal structure and the dynamic behavior of QM objects when calculating relative probabilities of their different states and properties.

5. Conclusion .

- This article may not answer in full some of the questions pertaining to a complex topic like "EPR effects". What we believe it does do, however, is provide theoretical insights which may help to analyze some of the perplexing experimental results in this area. That is, of course, if one has some faith in the validity of this PhR model.